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THE EFFECTS OF FEDERAL CREDIT PROGRAMS
ON FARM OUTPUT

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The Effects of Federal Credit Programs on Farm Output

Institutions with the direct or implied support of the federal government are the major lenders to the agricultural sector of the U.S. economy. In 1984, the Farm Credit System (FCS), a borrower-owned cooperative whose bonds carry an implied federal guarantee, held 32 percent of total outstanding farm debt. The Farmers Home Administration (FmHA), a federal agency that makes loans to farmers who are attempting to cope with emergency situations, held an additional 12 percent.^{1/}

One primary objective of these public credit programs is to facilitate agricultural production by providing credit that presumably would be unavailable to farmers. It seems unlikely, however, that private sector lenders would forego profitable lending opportunities. Moreover, even if there were some discrimination against farmers as borrowers, credit's fungibility would likely divert at least some public credit targeted for agriculture to higher-yielding investments, thus reducing its effect on agricultural production. The purpose of this paper is to discriminate between these hypotheses about the effects of public-sector lending to agriculture.

CREDIT IN A MODEL OF AGRICULTURAL OUTPUT

The Theory

Supporters of public lending to farmers stress that there are imperfections in the supply of credit to farmers by the private sector.^{2/} According to their argument, there are farmers who could earn profits on additional agricultural production if they could receive the credit to buy additional inputs; for some reason, however, this credit is unavailable from the private sector. Credit from public institutions, therefore, facilitates additional agricultural production.

If imperfections in the private credit market do not exist, however, the credit from the public institutions will not stimulate agricultural production. Instead, since agencies of the FCS and federal government typically lend to farmers at interest rates below those charged by private sector institutions, the public credit programs would tend to function more as a pure subsidy. In this view, variations in the subsidies would induce variations in the amount of credit demanded from the public agencies, but the borrowers, subject to the restrictions and monitoring of the public credit programs, could very well use the credit for purposes other than agricultural production.

Restrictions on the nonagricultural use of farm credit from public agencies can be circumvented in a variety of ways. Suppose a farmer receives subsidized credit from a public agency for the first time in the current year. If the farmer uses the funds from the public agency to buy his usual amount of farm inputs, his equity, which in prior years had been used to buy farm inputs, could be invested in nonagricultural concerns. Finding that credit from public institutions does not stimulate agricultural production would be consistent with the view that the public lending institutions provide subsidized credit to borrowers who have used the credit for nonagricultural purposes.

Specification of the Model

The role of credit as a determinant of agricultural output can be analyzed within a theoretical model of the demand for and supply of agricultural output. Credit is incorporated into the supply function under the assumption that farmers must borrow in order to increase the quantity of inputs they use in the production of agricultural commodities. Rather than estimating the demand and supply functions jointly, a reduced-form relationship between agricultural output and its determinants can be derived and estimated.

The following terms are used in specifying supply and demand functions for agricultural output.

- Q - output of the agricultural sector of the economy, in real terms, from the GNP accounts
- Q^D - demand for agricultural output
- Q^S - supply of agricultural output
- RGNP - real GNP
- P^A - price level for agricultural output
- P - general price level
- INPUT - real value of agricultural inputs
- PROD - productivity of agricultural inputs
- CREDIT - total farm credit divided by the GNP deflator

The demand and supply functions are presented in the form of changes, from one calendar year to the next, in the natural logs of all variables. Demand for agricultural output in each year is specified as a function of contemporaneous real GNP and the difference between the rates of change in agricultural prices and the GNP deflator:

$$\Delta \ln Q_t^D = a_0 + a_1 \Delta \ln \text{RGNP}_t + a_2 (\Delta \ln P_t^A - \Delta \ln P_t), \quad (1)$$

where $a_1 > 0$, $a_2 < 0$.

The supply function incorporates a lag in the relationship between the time at which farmers buy inputs and the time at which the output is available for sale. For grains, for instance, there is a lag between the time at which farmers buy seed and fertilizer and the time at which the crops are ready for harvest. The lags vary and typically are longer for livestock production. In the supply function specified in equation (2), agricultural production in the current calendar year is a function of the real value of agricultural inputs purchased by farmers in the prior year.

The index of productivity of farm inputs, another variable in the supply function, is derived by dividing an index of farm output by an index of farm inputs.^{3/} Constructed in this way, the index of productivity reflects both transitory influences, like weather, and more permanent influences, like new types of machinery, seeds and chemicals. Since a distinction between transitory influences and longer-term influences on the productivity of farm inputs is not crucial to the hypothesis under investigation, no attempt is made to separate those influences.

The final variable in the supply function is the difference between the growth rates of agricultural prices and the GNP deflator. This variable captures the responsiveness of the supply of agricultural production to changes in the relative price of agricultural commodities in the current year, given the investment of inputs made in the prior year.

The supply function then can be written as:

$$\begin{aligned} \Delta \ln Q_t^S = & b_0 + b_1 \Delta \ln \text{INPUT}_{t-1} + b_2 \Delta \ln \text{PROD}_t \\ & + b_3 (\Delta \ln P_t^A - \Delta \ln P_t), \end{aligned} \quad (2)$$

where b_1 , b_2 and $b_3 > 0$.

Credit is incorporated into the supply function through a third equation that specifies agricultural inputs as a function of the real value of agricultural credit. That is, by writing

$$\Delta \ln \text{INPUT}_t = c_0 + c_1 \Delta \ln \text{CREDIT}_t, \quad (3)$$

where $c_1 > 0$, it is possible to substitute the terms on the right side of equation (3) for the variable $\Delta \ln \text{INPUT}_{t-1}$ in equation (2). The reduced-form equation for agricultural output is derived by treating the supply and demand functions as a system of equations and solving for $\Delta \ln Q_t$:

$$\begin{aligned} \Delta \ln Q_t = & d_0 + d_1 \Delta \ln \text{RGNP}_t + d_2 \Delta \ln \text{PROD}_t \\ & + d_3 \Delta \ln \text{CREDIT}_{t-1}, \end{aligned} \quad (4)$$

where d_1 , d_2 , and $d_3 > 0$.

In this reduced form, equation (4), the relative price variable ($\Delta \ln P_t^A - \Delta \ln P_t$), which appears in both the supply and demand functions, is eliminated. The coefficients d_0 and d_1 through d_3 are combinations of the coefficients on the variables in equations (1) through (3).

To use equation (4) to test hypotheses about the effect of public sector credit on farm output, the aggregate credit variable must be disaggregated. A first refinement separates total credit into real estate and non-real estate debt. The presumption is that real estate debt should have little impact on output because it would be used primarily to finance transfers of ownership of farmland already in production. Thus, if credit has any effect on output, it should be associated with non-real estate credit used to purchase the variable inputs of production. Nonetheless, to test the effect of public sector lending for land purchases, the real estate component of farm credit is segmented further into that from Federal Land Banks (FLB) and all other (NFLB) sources.

A second division of total credit segments non-real estate credit into that provided by private sector lenders (commercial banks) and public sector lenders (FmHA and the Production Credit Associations

(PCAs) of the FCS). The result necessary to support the assertion that public sector lending to agriculture increases farm output is a significant and positive coefficient for either of these latter two variables. The coefficients on credit from public sector sources need not be as large as those on private credit, because credit from the public institutions may finance the operations of the least efficient farmers.^{4/}

ESTIMATION

Farm output, the dependent variable in regressions reported in table 1, is measured as the real value of U.S. gross domestic product in the farm sector. Annual data are used in estimating farm output as a function of the determinants of supply and demand identified above. The number of annual observations is constrained by the availability of data on farm credit. Data on total farm debt, divided into the real estate and non-real estate components, are available since 1940. These data are used in regression (1) of the table. Data for selected categories of lenders are available from 1934 and are the basis of equations (2) and (3).

In all three regression equations reported in the table, the coefficients on real GNP are not significantly different from zero.^{5/} The

coefficient on the index of productivity is positive and highly significant in each equation.

The results in equation (1) concerning the credit variables conform to expectations. The coefficient on non-real estate credit is highly significant, but that on real estate credit is not significantly different from zero.^{6/} This equation establishes the significance of non-real estate farm credit as a determinant of farm output, but does not identify a unique role for public sector provision of that credit.

Regression (2) examines the effects on farm output of credit supplied by private and public sector lenders. Of the real estate credit, neither that from the Federal Land Banks nor that from other sources has a significant influence on farm output. These results refute the notion that farm output would be adversely affected by a deficiency in privately supplied credit for farmland purchases and question one of the primary rationales for the existence of the Federal Land Banks.

The coefficients on non-real estate credit from the FmHA and from commercial banks (BANK) are positive and statistically significant at the 5 percent level and the coefficient on PCA credit is almost significant at the 5 percent level. If the latter significance test is interpreted as a one-tail

test for a positive coefficient, the coefficient on PCA credit also would be significant at the 5 percent level. These results support the view that public sector lending for the purchase of variable inputs does increase farm output.

It should be recalled, however, that the observations on farm output and farm credit for about the first 10 years of data used in equation (2) reflect unusual circumstances. The years include part of the Great Depression, when the banking system was weakened by widespread failures, and World War II, which had substantial effects on resource allocation. Assuming that the weakness of the banking system and poor returns in agriculture discouraged farm lending during this period, credit from government agencies may have been more important in facilitating agricultural production than during later periods.

Equation (3) includes variables that are designed to isolate unique influences for the years 1936-45 in testing the effects of government credit programs on agricultural production. Each of the components of non-real estate debt in equation (2) is multiplied by a dummy variable with a value of unity in the first years through 1945 and zero for subsequent years. Including the additional variables changes the results substantially. Most important, the coefficients on credit from PCAs and the FmHA are

insignificant in regression (3). Also supporting the view that public credit programs may have filled a credit gap in the Depression and war years is the negative and nearly significant coefficient for the commercial bank credit slope dummy. The bank credit coefficient is 0.132 for the 1946-84 period, up from 0.085 in regression (2).

Thus, with variables included to factor out unique influences in the years 1936 through 1945, the influences of PCA and FmHA credit become insignificant. These results again reject a traditional rationale for public sector lending to agriculture: reduced farm output associated with insufficient credit supplied by private sector lenders. Finally, the results from regression (3) suggest that the significance of non-real estate credit as a determinant of farm output initially reported in regression (1) comes primarily from the influence of commercial bank credit on farm output.

CONCLUSIONS

Institutions with the direct or implied support of the federal government are major lenders to farmers. One justification for this federal involvement in the supply of farm credit is that there are imperfections in the supply of credit to farmers by the private sector. According to this

view, some farmers could earn profits on their marginal production if they could receive more credit, but private credit markets will not supply the additional credit.

This rationale for the farm credit programs is based on a hypothesis about the influence of farm credit on farm output that can be tested empirically. Regression results indicate that total non-real estate farm credit does have a positive and statistically significant influence on farm output. Results based on time series from 1934 further indicate that non-real estate credit from public and private sources have positive and statistically significant effects on farm output. With independent variables included to factor out influences unique to the Depression and war years through 1945, however, only credit from commercial banks has a significant influence on farm output. Thus, while the results indicate an important role for non-real estate credit in facilitating agricultural production, they do not support the role of the federal agencies in providing that credit.

FOOTNOTES

1/ Barry and Boehlje (1986), pp. 129-30.

2/ Meekhof (1984) and Barry and Boehlje (1986),
pp. 129-30.

3/ See Ball (1985) for an analysis of measures
of productivity in U.S. agriculture.

4/ Barry and Boehlje (1986), pp. 137-41.

5/ Real GNP also has an insignificant
coefficient with that variable lagged one year.

6/ Estimation of the relationships expressed in
equation (4) with contemporaneous values for the
credit variables led, uniformly, to no significant
coefficients for any measure of farm credit.

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Table 1
Response of Farm Output to Changes in Credit

Independent Variable	Regression number		
	(1) 1941-1984	(2) 1936-1984	(3) 1936-1984
Intercept	-0.009 (-1.676)	-0.009 (-1.718)	-0.007 (-1.000)
$\Delta \ln \text{RGMP}_t$	-0.082 (-0.883)	-0.043 (-0.464)	-0.007 (-0.076)
$\Delta \ln \text{PROD}_t$	0.854 (10.458)	0.882 (10.847)	0.855 (9.794)
$\Delta \ln \text{REDEBT}_{t-1}$	-0.042 (-0.562)		
$\Delta \ln \text{NREDEBT}_{t-1}$	0.203 (3.788)		
$\Delta \ln \text{FLB}_{t-1}$		0.048 (0.412)	0.103 (0.738)
$\Delta \ln \text{NFLB}_{t-1}$		-0.066 (-0.926)	-0.063 (-0.880)
$\Delta \ln \text{PCA}_{t-1}$		0.014 (1.955)	-0.068 (-0.892)
$\Delta \ln \text{PCA}_{t-1} \times \text{D}$			0.081 (1.056)
$\Delta \ln \text{FHMA}_{t-1}$		0.067 (2.183)	0.051 (1.498)
$\Delta \ln \text{FHMA}_{t-1} \times \text{D}$			0.034 (0.372)
$\Delta \ln \text{BANKS}_{t-1}$		0.085 (2.180)	0.132 (2.834)
$\Delta \ln \text{BANKS}_{t-1} \times \text{D}$			-0.131 (-1.799)
R^2	0.78	0.78	0.80
D.W.	1.85	1.94	1.87
D.F.	38	41	38

NOTE: t-statistics in parentheses under regression coefficients

Terms:

(all credit measures are in real terms, divided by the GNP deflator)

- RGMP - real gross national product in the U.S.
- PROD - an index of productivity of farm inputs
- REDEBT - real estate debt of the farm sector
- NREDEBT - nonreal estate debt of the farm sector
- FLB - farm real estate debt owed to the Federal Land Banks
- NFLB - farm real estate debt other than that owed to the Federal Land Banks
- PCA - nonreal estate farm debt owed to the Production Credit Associations
- FHMA - nonreal estate farm debt owed to the Farmers Home Administration
- BANKS - nonreal estate farm debt owed to commercial banks
- D - dummy variable with the value of unity for 1936 through 1945, zero for other years.

APPENDIX

A DESCRIPTION OF FEDERAL AGENCIES THAT LEND TO FARMERS 1/

Farm Credit System

The Farm Credit System (FCS) is a confederation of federally chartered, borrower-owned financial cooperatives. FCS raises funds in the national money markets and makes loans to farmers, rural banks and other farmer cooperatives. It is composed of three lending systems, a regulating organization, a government affairs organization and a funding agency. There are 12 district Federal Land Banks (FLBs), each of which is owned by local cooperatives called Federal Land Bank Associations (FLBAs). FLBAs are in turn owned by member borrowers who are farmers and ranchers. There are also 12 Federal Intermediate Credit Banks (FICBs), owned principally by local cooperatives called Production Credit Associations (PCAs). PCAs are also owned by farmers and ranchers. Finally, there are 12 district level Banks for Cooperatives (BCs) and one Central Bank for Cooperatives. All the BCs are owned by their member-borrowers. Since they lend to farmer cooperatives, ultimate ownership is by farmers and ranchers. Exceptions occur when rural banks sell farm loans to the FCS or when loans are made to individuals who own farm assets but are not farm operators. Thus, these groups end up owning a small fraction of the system.

The FCS is regulated by the Farm Credit Administration (FCA). The FCA assures that legal restrictions on the activities of the FCS are followed and acts as a central information source for the system. All of the expenses of the FCA are paid for by the system so no taxpayer expense is involved.

The fiscal agent of the system, the Federal Farm Credit Banks Funding Corporation, is located in New York City. The funding corporation sells debt obligations of the FCS to investors and distributes the proceeds from selling the debt obligations to the units of the FCS that make credit available to farmers.

The FLBs and FLBAs are the largest lenders of farm real estate debt. They were established in 1916 to lengthen the maturity of farm real estate debt. Before then, the normal maturity for a real estate loan was about five years. It was difficult for the land to generate sufficient returns to repay both principal and interest in such a short period of time.

The FICBs and PCAs are the second-largest lenders of non-real estate farm debt. The FICBs were established in 1923 to overcome periodic shortages of short- and intermediate-term debt funds in rural financial markets. They originally were established with the idea that commercial banks would make farm loans, sell the loans to the FICBs and, thus, have

more funds to lend to other farmers. Bank discounting of farm loans was not widely accepted, so the PCA system was established in 1933 to provide a direct link between national money markets and farm operating loan demand.

The BC system was established in 1933 to provide credit to farmer cooperatives. The objective of the BCs is to promote the growth of various types of farm cooperatives by providing them with a source of credit.

The FCS is classified as a government agency, and thus is able to borrow at interest rates only slightly greater than the U.S. Treasury. The interest on its bonds generally is considered to be free from state and local taxes. The Federal Land Banks, the Federal Land Bank Associations and the Federal Intermediate Credit Banks do not pay federal income taxes.

The Farmers Home Administration

FmHA is the primary rural credit agency of the federal government. It was created as part of the U.S. Department of Agriculture in 1946 to provide credit to rural residents unable to obtain credit from private lenders. FmHA took over and expanded the functions of the Farm Security Administration and the Rural Resettlement Administration. Since 1960,

FmHA loans have grown by over 4,000 percent. Most of the growth occurred in the 1970s when the scope of the organization's objectives experienced a major revision.

The FmHA lending programs are intended to serve only rural residents who are unable to obtain credit elsewhere. As such, FmHA was designed to be a "lender of last resort" to rural America, funding creditworthy projects that private lenders were either unable or unwilling to finance.

Originally, FmHA operating loans and farm ownership loans were developed to help beginning farmers who did not qualify for private financing because of inadequate collateral or lack of experience with large amounts of debt. The Emergency Disaster Program provided funds for farmers who had sustained a significant loss from natural disasters beyond their control. Starting a farm and recovering from natural disasters were considered temporary conditions, and farmers were expected to "graduate" from these programs to private credit within a specified number of years. Soil and water loans facilitated long-term improvements to the land that were in best interest of society. Such projects may never have generated sufficient returns to private landowners to be undertaken with market interest rates.

In 1978, a new farm program was introduced entitled the Economic Emergency Loan Program. This program authorized the FmHA to make loans to farmers when credit was scarce due to monetary policy, low product prices or high production costs. While on the surface this new program was similar to existing programs, its implementation brought a whole new role to FmHA. Instead of overcoming temporary market failures by lending to farmers who eventually would graduate to private credit, this program put the FmHA in the position of stopping sector level adjustments to changes in the economy. If, for example, a new technology changed the supply of food so prices fell, all lenders would qualify for FmHA financing. If the shift to lower prices was permanent, those farmers might never be expected to graduate. As the implications of this program became evident, the program's funding was reduced, and few new loans have been made since 1982.

The Commodity Credit Corporation

The Commodity Credit Corporation originated in 1933 as part of a set of farm programs designed to support and stabilize farm commodity prices. The CCC provides nonrecourse loans to eligible farmers and farmer cooperatives to help finance orderly marketing and support the prices of targeted crops. A

nonrecourse loan is one that can be repaid either by paying back principal and interest or forfeiting collateral. Since crops are the collateral for these loans, the amount loaned serves as a minimum farmers have to accept for their production. If market prices are too low, the farmer forfeits the crop to the CCC and keeps the money from the loan. If prices are sufficiently high, they sell their crops and repay the loan in a normal fashion.

Tables A1 and A2 provide information on the share of the farm sector's real estate and non-real estate debt held by public agencies in recent decades. The shares of real estate farm credit held by the Federal Land Banks and the Farmers Home Administration have risen substantially since 1950. Together, these government agencies held over half of the real estate debt in 1984, compared with 20 percent as recently as 1955.

The share of non-real estate farm debt held by the PCAs was three times higher in 1984 than in 1955. The share held by the FmHA has risen most sharply since 1975. Commercial banks have maintained the share of non-real estate debt in the 1980s that they had in prior decades. The share held by individuals and others has been declining rapidly since the 1960s.

APPENDIX FOOTNOTES

1/ This appendix is based largely on the description by Hughes (1986).

Table A1
Real Estate Farm Debt, Outstanding, January 1

	<u>Federal Land Banks</u>	<u>Life Insurance Companies</u>	<u>Commercial Bank</u>	<u>Farmers Home Administration</u>	<u>Individuals and Others</u>
1950	17.3%	21.0%	16.7%	3.6%	41.4%
1955	15.5	24.9	14.1	4.6	40.9
1960	19.2	23.1	12.5	5.5	39.6
1965	19.5	22.7	12.8	6.8	38.2
1970	22.9	19.6	12.1	7.8	37.5
1975	30.0	14.1	13.4	7.2	35.3
1980	34.7	14.2	10.1	8.3	32.7
1984	43.0	11.4	8.3	8.3	29.0

Table A2
Non-real Estate Farm Debt, Outstanding, January 1

	<u>Production Credit Associations</u>	<u>Other Financing Institutions</u>	<u>Commercial Banks</u>	<u>Individuals and Others</u>	<u>Farmers Home Administration</u>	<u>Commodity Credit Corporation</u>
1950	5.6%	0.7%	29.8%	33.7%	5.0%	25.0%
1955	6.1	0.6	31.2	34.1	4.4	23.6
1960	10.7	0.7	38.0	38.3	3.1	9.2
1965	12.7	0.7	39.0	35.3	3.6	8.6
1970	18.9	0.9	43.3	22.4	3.3	11.2
1975	25.6	1.0	49.3	20.4	2.8	0.9
1980	22.4	0.8	38.6	20.7	11.2	6.3
1984	18.2	0.8	37.9	18.4	14.2	10.5
